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IS 9968 (Part 2) : 2002

भारतीय मानक

इलास्टोमर विद्युत रोधी केबलों की विशिष्टि

भाग 2 3.3 किवो से 33 किवो कार्यकारी वोल्टता के लिए

(पहला पुनरीक्षण)

Indian Standard

SPECIFICATION FOR ELASTOMER — INSULATED CABLES

PART 2 FOR WORKING VOLTAGES FROM 3.3 kV UP TO AND INCLUDING 33 kV

(First Revision)

ICS 29.035.20,29.060.20

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 2002

Price Group 5

Power Cables Sectional Committee, ETD 09

FOREWORD

This Indian Standard (Part 2) (First Revision) was adopted by the Bureau of Indian Standards after the draft finalized by the Power Cables Sectional Committee had been approved by the Electrotechnical Division Council

The requirements for rubber insulated cables were initially covered in IS 434 first published in 1953 and subsequently revised in 1964 However this specification was again revised in 1981 to include latest development of synthetic rubber insulating and sheathing material and a new number IS 9968 was allotted and the internationally accepted term elastomer has been used in place of rubber

In this revision the mining type cables have been deleted and incorporated in a new part (Part 3 Flexible cables for use in mines) and the voltage grade has been extended to include 19/33 kV Also unearthed grade has been deleted

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 1960 'Rules for rounding off numerical values (*revised*)' The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard

AMENDMENT NO. 1 FEBRUARY 2006
TO
IS 9968 (PART 2) : 2002 SPECIFICATION FOR ELASTOMER INSULATED CABLES

PART 2 FOR WORKING VOLTAGES FROM 3.3 kV UP TO AND INCLUDING 33 kV

(First Revision)

(*Second cover, Foreword, para* 3, *line* 1) — Substitute 'in the new specification IS 14494 1998 Elastomer insulated flexible cables for use in mines (*superseding* IS 691 and IS 1026)' *for* 'in a new part (Part 3 Flexible cables for use in mines)'

(ET 09)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 2 NOVEMBER 2007
TO
IS 9968 (PART 2) : 2002 SPECIFICATION FOR ELASTOMER — INSULATED CABLES

PART 2 FOR WORKING VOLTAGES FROM 3.3 kV UP TO AND INCLUDING 33 kV

(First Revision)

(*Page* 1, *clause* **2**) — Substitute 'Low carbon galvanized steel wires, formed wires and tapes for armouring of cables — Specification (*third revision*)' for the existing title of IS 3975 1999

(*Page* 3, *clause* **20.2.1**, *last line*) — Add the following matter at the end

"The tolerance on nominal dimensions shall be as per IS 3975 However, for formed steel wires compliance shall be ensured only for dimensions 'A' & 'C' "

(*Page* 4, *clause* **20.2 2**, *para* 2) — Substitute the following for the existing matter

Diameter of braiding wires shall be in accordance with Table 6 The tolerance on nominal dimensions shall be as per IS 3975 '

(*Page* 4, *clause* **20 3**) — Insert the following new clause after **20.3**.

'**20.4** The round steel wires/formed steel wires taken from the cable shall meet the following requirements

a) The tensile strength of round steel wire/formed steel wire shall be not less than 250 N/mm^2 and not more 580 N/mm^2

b) The Elongation at break of round steel wire/formed steel wire shall be not less than 6 percent

c) Round steel wire shall meet the requirements of torsion test The gauge length between Vices and the minimum number of turns without break shall be as per Table 6 of IS 3975

d) The zinc coating shall not show any cracks and shall not flake off on rubbing by the bare finger when the formed steel wire is subjected to winding test

e) The uniformity of zinc coating of round steel wire/formed steel wire shall comply with the requirements of IS 3975 subject to the following

- The minimum number of dips shall be reduced by one half-minute dip
- In case of formed wires, dip test is applicable only for the face

f) The mass of zinc coating of round steel wire shall be not less than 95 percent of the mass specified in Table 2 of IS 4826. The mass of zinc coating of formed steel wire shall be not less than 95 percent of the mass specified in IS 3975

g) The resistivity of the round steel wire/formed steel wire shall meet the requirements of IS 3975’

[*Page* 5, *clause* 22.1, *Sl No* (b)] — Substitute the following for the existing

b) Tests for round steel wire/formed steel wire (strip) armour		
1) Dimensions	20.2.1 & 20.2.2 of IS 9968 (Part 2)	Part 36 of IS 10810
2) Physical tests on round/formed wire		
i) Tensile strength	20.4(a) of IS 9968 (Part 2)	Part 37 of IS 10810
ii) Elongation at break	20.4(b) of IS 9968 (Part 2)	Part 37 of IS 10810
iii) Torsion test for round wires	20.4(c) of IS 9968 (Part 2)	Part 38 of IS 10810
iv) Winding test for formed wires	20.4(d) of IS 9968 (Part 2)	Part 39 of IS 10810
v) Uniformity of zinc coating	20.4(e) of IS 9968 (Part 2)	Part 40 of IS 10810
vi) Mass of zinc coating	20.4(f) of IS 9968 (Part 2)	Part 41 of IS 10810
vii) Resistivity	20.4(g) of IS 9968 (Part 2)	Part 42 of IS 10810

(ET 09)

Indian Standard

SPECIFICATION FOR ELASTOMER — INSULATED CABLES

PART 2 FOR WORKING VOLTAGES FROM 3.3 kV UP TO AND INCLUDING 33 kV

(First Revision)

SECTION 1 GENERAL

1 SCOPE

1.1 This standard (Part 2) covers the requirements of heat resisting elastomer insulated cables for fixed installations and flexible cables for single phase or three phase system, suitable for voltage (U_0/U) 1 9/3 3, 3 8/6 6, 6 35/11, 12 7/22 and 19/33 kV for electricity supply purposes

NOTES

1 For unearthed voltage grade following selection procedure to be adopted

Cables of 1 9/3 3 kV 6 35/11 kV and 12 7/22 kV grades (earthed systems) are also suitable for use on 3 3/3 3 kV 6 6/6 6 kV and 11/11 kV grades (unearthed systems) respectively

2 The cables conforming to this standard may be operated continuously at a power frequency voltage 10 percent higher than rated voltage

3 Under Rule 54 of the *Indian Electricity Rules* 1956 in case of high voltage the permissible variations of declared voltage at the point of commencement of supply is $^{+6}_{9}$ percent

1.2 These cables are suitable for use where combination of ambient temperature and temperature rise due to load results in conductor temperature not exceeding 90°C under normal operation and 250°C under short circuit conditions

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard

IS No	*Title*
1885 (Part 32) 1993	Electrotechnical vocabulary Part 32 Electric cables (*first revision*)
3975 1999	Mild steel wires, formed wires and tapes for armouring of cables (*third revision*)
4905 1968	Methods for random sampling
5831 1984	PVC insulation and sheath of electric cables (*first revision*)
6380 1984	Elastomeric insulation and sheath of electric cables (*first revision*)
8130 1984	Conductors for insulated electric cables and flexible cords (*first revision*)
10418 1982	Specification for drums for electric cables
10462 (Part 1) 1983	Fictitious calculation method for determination of dimensions of protective coverings of cables Part 1 Elastomeric and thermoplastic insulated cables

3 TERMINOLOGY

The definitions given in IS 1885 (Part 32) shall apply

SECTION 2 MATERIALS

4 CONDUCTORS

4.1 Cables for Fixed Installation

The conductors shall consist of either tinned copper or aluminium and shall conform to IS 8130

4 2 Flexible Cables

The conductor shall consist of tinned copper and shall conform to IS 8130

5 INSULATION

The insulation shall be of elastomer compound conforming to Type IE 3 of IS 6380

6 SEMICONDUCTING COMPOUND

The semiconducting compound shall be so formulated as to be suitable for the operating temperature of the cable both during sustained operation and during short circuit and shall have no deleterious effect on the cable insulation

7 TAPE

7.1 Proofed Tape

The proofed tape shall be closely woven textile without selvedge, proofed on one side with rubber The thickness of the tape should be approximately 0 15 mm

7.2 Polyethylene Terephthalate (PETP) or Polypropylene Base Tape

The thickness of the tape shall be between 0 01 mm and 0 05 mm

7.3 Any other suitable tape based on glass, textile composite or other synthetic material may be used

8 SCREENING

The screening shall consist of one or more of the following

a) Non-metallic semi-conducting tape,

b) Non-metallic semi-conducting compound, and

c) Non-magnetic metallic tape, wire, strip or sheath

NOTES

1 The semiconducting tape and semiconducting compound shall be suitable for the operating temperature of the cable and compatible with the insulating material

2 Non magnetic metallic tape, wire or strip shall be compatible with the insulation and sheathing material used

9 CENTRE AND FILLERS

The centre and filler shall be any one or a combination of the following and shall be non-hygroscopic

a) Fibrous materials,

b) Elastomeric compound (including regenerated or unvulcanized rubber),

c) Plastic compounds, and

d) Material similar to inner sheath

NOTES

1 Material used shall be suitable for the operating temperature of the cable and shall have no deleterious effect on any other component of the cable

2 The fillers at the manufacturers discretion may form an integral part of the rubber sheath

3 The elastomeric centre and filler may be reinforced with fibrous material or metallic wires Where metallic wires are used it shall be earthed

10 ARMOUR

Armour shall consist of one of the following

a) Galvanized round steel wires conforming to IS 3975,

b) Galvanized formed wires conforming to IS 3975, and

c) Any non-magnetic material (as agreed to between the purchaser and the manufacturer)

11 SHEATH

11.1 Inner Sheath

The inner sheath shall consist of elastomeric compound complying with requirements of Type SE 3 of IS 6380

NOTE For certain applications a soft inner sheath may be required In such cases it shall be as agreed to between the manufacturer and the user

11.1.1 In cables for fixed installations, the inner sheath may also consist of Type ST 2 PVC compound conforming to IS 5831

11.1.2 Elastomeric outer sheath is not recommended for cables having PVC inner sheath

11.2 Outer Sheath

The outer sheath shall be of elastomeric compound conforming to Type SE 4 of IS 6380

11.2.1 In cables for fixed installations the outer sheath may also consist of Type ST 2 PVC compound conforming to IS 5831

12 REINFORCEMENT MATERIAL

12.1 Tapes

The proofed tape shall be closely woven textile without selvedge, proofed on one side with rubber The thickness of the tape should be approximately 0 15 mm

12.2 Cords and Yarns

Cords and yarns, wherever used for reinforcement, shall be either cotton or synthetic cords or yarns

SECTION 3 CONSTRUCTION

13 CONDUCTORS

13.1 Cables for Fixed Installations

The conductors shall be of stranded construction, complying with Class 2 of IS 8130

13.2 Flexible Cables

The conductors shall be in accordance with Class 5 of IS 8130

13.3 Earthing Conductor

The minimum size of the earthing conductor, if any, shall be as given in Table 1 The conductor may be bare or covered

13.3.1 For flexible cables, it is permissible to split up the earthing conductor into equal parts and to place them in the interstices

13.4 Separator Tape

A suitable separator tape(s) may be applied between the conductor and insulation

14 CONDUCTOR SCREENING

All cables rated above 3 8/6 6 kV shall be provided with conductor screening It shall be provided over the conductor by applying non-metallic semiconducting tape(s) or by extrusion of semiconducting compound or a combination of both

15 INSULATION

15.1 The conductor (with either separator or screen, wherever applicable) shall be provided with elastomeric insulation The insulation shall be so applied that it fits closely on the conductor (with or without separator or conductor screen) but shall not adhere to it

15.2 Thickness of Insulation

The average thickness of insulation shall be not less than the nominal value (t_i) specified in Table 2 The thickness of any separator or semiconducting screening on the conductor shall not be included in the thickness of insulation

15.3 Tolerance on Thickness of Insulation

The smallest of measured values of thickness of insulation shall not fall below the specified values (t_i) by more than 0.1 mm + 0.1 t_i

16 INSULATION SCREENING

16.1 All cables rated above 3.8/6.6 kV shall be provided with insulation screening

16.2 The insulation screening shall consist of two parts, namely metallic and non-metallic

16.3 Non-metallic part shall be applied directly over the insulation of each core and shall consist of either semiconducting tape(s) or extruded semiconducting compound or a combination of the two or either material with a semiconducting coating

16.4 Metallic part shall consist of either tape or braid, or concentric serving of wires or a sheath, shall be non-magnetic and shall be applied over the non metallic part For single core armoured cables, it is permissible to apply the non-magnetic armouring over the non metallic screen and it shall constitute the metallic part of the screening

NOTES

1 If the application requires any minimum values of conductance of the metallic part of insulation screen this shall be as agreed to between the manufacturer and the user

2 For cables subjected to repeated flexing in service (for example in reeling drums) it is permissible to apply insulation screen consisting of non metallic semiconducting extruded screen alone In such cases the earthing conductor is to be provided and the insulation screen shall meet the requirements of the test specified in Annex B

3 If copper wire/tape is used as metallic part of insulation screen it shall be tinned if the overlying sheath is of elastomeric material However it can be untinned if PVC sheath is used

17 CORE IDENTIFICATION

Cores shall be identified by the use of coloured strips/tapes (Red, Yellow, Blue for phase conductors) applied on the cores, Alternatively, numbered strip tapes or by printing of numbers (1 2 3) on the cores is permissible When numerals are printed for identification these shall appear at intervals of not greater than 150 mm Earth cores need not be identified but if required, it can be either by green coloured strip/tapes applied on cores or by numbered strip/tapes or printing numerals 0

For unscreened cables, identification of cores by use of coloured insulation compound is also permissible

18 LAYING UP OF CORES

18.1 The cores shall be laid up with a suitable right hand lay For flexible cables the length of lay shall not exceed the following

Up to 25 mm²	15 times pitch circle diameter
Above 25 mm²	18 times pitch circle diameter

Fillers in the interstices may be provided to give a reasonable circularity of cores

18.2 For flexible cables, there shall be no undue restraint on the relative movements of cores when the cable is flexed

18.3 A binder tape may be applied over laid up cores

19 INNER SHEATH

19.1 The laid up cores shall be provided with an inner sheath applied by extrusion in such a way that it fits closely on laid-up cores and it shall be possible to remove it without damage to the insulation Unarmoured cables shall generally have no inner sheath except where otherwise stated or as agreed to between the manufacturer and the user

19.2 Thickness of Inner Sheath

The thickness of inner sheath at any point shall not be less than the value given in Tables 3 and 4

19.3 A proofed tape may be applied over the inner sheath at the discretion of the manufacturer

20 ARMOURING

20.1 The armour, wherever required shall be applied over the insulation or non-metallic part of the insulation screen, if any in case of single core cables and over the inner sheath in case of multicore cables

20.2 Type of Armour

20.2.1 *Cable for Fixed Installations*

Armour shall consist of galvanized steel wires formed wires to give a reasonable close cover The size of armour shall be as given in Table 5

20.2.1.1 In case of single core cables, the armouring shall be of non-magnetic material

20.2.1.2 Direction of lay of armour shall be left hand. For double wires/formed wires armoured cables, this requirement shall apply to inner layer. The outer layer shall be applied in the reverse direction to the inner layer and there shall be a separator tape of suitable non-hygroscopic material between the layers.

20.2.1.3 When joints in armour wires/formed wires are necessary, these shall be brazed or welded and surface irregularities removed. A joint in any wire/formed wire shall be at least 300 mm from the nearest joint in any other armour wire/formed wire in the completed cable.

20.2.2 *Flexible Cable*

The armour shall consist of a braid of either galvanized steel wires or non-magnetic metallic wires and shall be so applied so as to give a minimum filling factor of 0.57.

Diameters of braiding wires shall be in accordance with Table 6.

NOTE — Filling factor for braid is given by the following formula:

$$F = \frac{mnd}{2\pi D}\left[\frac{1+\pi^2 D^2}{L^2}\right]^{1/2}$$

where

F = Filling factor for braid,
m = Total No. of spindles,
n = Total No. of ends per spindle,
d = Diameter of braiding wire (mm),
D = Mean diameter of braid (mm), and
L = Lay of braiding wire (mm).

20.2.2.1 In case of single core cables, the braiding wherever required shall be of non magnetic material.

20.3 Substitution of the galvanized steel wires/formed wires in armour by required number of tinned copper wires/formed wires is permissible in order to meet specific conductance requirement of armour, if agreed to between the manufacturer and the purchaser.

21 OUTER SHEATH

21.1 The outer sheath shall be applied by extrusion. It shall be applied as follows:

a) Over the non-magnetic metallic part of the insulation screening in case of single core screened unarmoured cables.
b) Over the inner sheath or laid up cores in case of three-core unarmoured cables.
c) Over the armouring in case of armoured cables.
d) Over the taped/untaped insulated core in case of single core unscreened unarmoured cable.

21.2 Colour of outer sheath shall be black or any other colour as agreed to between the purchaser and the supplier.

NOTE — A longitudinal mark of contrasting colour may be provided on the outer sheath to identify any twist in the cable as per specific agreement between the purchaser and the supplier.

21.3 Thickness of Outer Sheath

21.3.1 *Unarmoured Cables*

The thickness of outer sheath of unarmoured cables determined by taking the average of number of measurements shall not be less than the minimum value (t_s) specified in Tables 3 or 4 and the smallest of the measured values shall not fall below the minimum value specified in Tables 3 or 4.

NOTES

1 *For heavy duty unarmoured flexible three core cables with* repeated flexing in service, it is recommended that two sheaths be applied one over the laid up cores as inner sheath in accordance with **19** and the other over this as outer sheath in accordance with **21**. Reinforcing material may be applied between the two sheaths. This can be in the form of either a tape or an open braid.

2 In case of two layers of sheath with non metallic reinforcement in between (that is inner sheath, reinforcement and outer sheath) the total combined thickness of two layers of sheath with the reinforcement shall be measured which shall satisfy the sum of the thicknesses of inner and outer sheaths.

21.3.2 *Armoured Cables*

The thickness of outer sheath of armoured cables shall not fall below the minimum value specified in Tables 3 or 4.

SECTION 4 TESTS

22 CLASSIFICATION OF TESTS

22.1 Type Tests

The following shall constitute type tests:

Tests	*For Requirements Ref to*	*For Test Methods Ref to Part of IS 10810*
a) Tests on Conductor	IS 8130	1
1) Annealing test (for copper)		
2) Tensile test (for aluminium)	-do-	2
3) Wrapping Test (for aluminium)	-do-	3
4) Conductor resistance test	-do-	5
5) Persulphate test (tinned copper conductor)	-do-	4

b) Test for Galvanized Steel Wires/Formed Wires		
1) Dimensions	IS 3975 (Tables 5 & 6)	36
2) Tensile strength and elongation at break	-do-	37
3) Torsion (for round wires only)	-do-	38
4) Winding (for strips only)	-do-	39
5) Zinc coating	-do-	40 & 41
c) Physical Tests for Insulation and Sheath (as applicable)		
1) Thickness of insulation and sheath	15 19 and 21 of this standard	6
2) Tensile strength and elongation at break	IS 6380 IS 5831	7
3) Ageing in air oven	-do-	11
4) Ageing in air bomb	IS 6380	56
5) Hot set test	do	30
6) Oil resistance test	-do	31
7) Tear resistance test	-do-	17
8) Shrinkage test	IS 5831	12
9) Hot deformation test	-do	15
10) Loss of mass in air oven	-do-	10
11) Heat shock	do	14
12) Thermal stability	do	60
d) Insulation Resistance Test	IS 6380	43
e) Partial Discharge Test	23 2 of this standard	46
f) Bending Test Followed by Partial Discharge Test	23 3 of this standard	50
g) Dielectric Power Factor Test	23 4 of this standard	48
1) As a function of voltage		
2) As a function of temperature		
h) Heating Cycle Test Followed by Partial Discharge Test	23 5 of this standard	49
j) Impulse Withstand Test	23 6 of this standard	47
k) High Voltage Test for Four Hours	23 7 of this standard	45
m) Water Absorption Test	IS 6380	28
n) Flammability	23 8 of this standard	53

22.1.1 Tests (e), (f), (g), (h) and (j) are applicable to screened cables, that is, cables with rated voltage above 2 8/6 8 kV

22.1.2 For 6 35/11, 12 7/22 and 19/33 kV cables, the following electrical type tests shall be performed successively on the same sample of completed cable not less than 10 m in length between test accessories except for tests at (a), (d), (e) and (f) which may be carried out on different samples

a) Insulation resistance at room temperature

b) Partial discharge test,

c) Bending test followed by partial discharge test,

d) Dielectric power factor as a function of voltage

e) Dielectric power factor as a function of temperature

f) Insulation resistance measurement at maximum continuous operating temperature,

g) Heating cycle test followed by partial discharge test,

h) Impulse withstand test and

j) High voltage test for four hours

22.1.2.1 If the sample fails in test (j) a new sample may be taken for this test, preceded by tests (c) and (g)

22.1.3 In multicore cables, each test or measurement shall be carried out on all the cores

22.2 Acceptance Tests

The following shall constitute the acceptance tests

a) Annealing test (for copper),

b) Tensile test (for aluminium),

c) Wrapping test (for aluminium)

d) Conductor resistance test

e) Test for thickness of insulation and sheath

f) Tensile strength and elongation at break test of insulation and sheath

g) Hot set test for elastomeric insulation and sheath

h) Partial discharge test (for 11 22 and 33 kV cable only),

j) High voltage test,

k) Insulation resistance (volume resistivity) test and

m) Electrical test on semiconducting non-metallic screen (Annex B) only for non-metallic screened cable

NOTE — Partial discharge test shall be carried out on full drum length

22.2.1 A recommended sampling plan for acceptance tests is given at Annex A

22.3 Routine Tests

The following shall constitute the routine tests

- a) Conductor resistance test,
- b) Partial discharge test (for screened cables only), and
- c) High voltage test.

NOTE — Partial discharge test shall be carried out on full drum length.

22.4 Optional Tests

The following shall constitute optional tests:

- a) Ozone resistance test (IS 6380), and
- b) Cold impacts test for PVC sheath (IS 5831).

23 DETAILS OF TESTS

23.1 General

Unless otherwise stated in this standard, the tests shall be carried out in accordance with appropriate part of IS 10810 taking into account additional information given in this standard.

23.2 Partial Discharge Test

The partial discharge magnitude at test voltage equal to 1.5 U_0 shall not exceed 20 pC.

23.3 Bending Test

The diameter of test cylinder shall be 20 $D \pm 5$ percent for cables for fixed installation and 8 $D \pm 5$ percent for flexible cables, where D is the overall diameter of the completed cable. After bending operations the test sample shall be subjected to partial discharge measurements and shall comply with the requirements given in **23.2**.

23.4 Dielectric Power Factor (Tan δ) Test

23.4.1 *Tan δ as a Function of Voltage*

The measured value of tan δ at U_0 shall not exceed 0.02 and the increment of tan δ between 0.5 U_0 and $2U_0$ shall not exceed 0.002 5.

23.4.2 *Tan δ as a Function of Temperature*

The measured value tan δ shall not exceed 0.02 at ambient temperature and 0.04 at 90°C.

23.5 Heating Cycle Test

The sample which has been subjected to previous tests, shall be laid out on the floor of the test room and subjected to heat cycles. After third cycle, the sample shall be subjected to partial discharge test (**23.2**).

23.6 Impulse Withstand Test

Impulse voltage level shall be 75 kV for 6.35/11 kV, 125 kV for 12.7/22 kV and 170 kV for 19/33 kV cables.

23.7 High Voltage Test

23.7.1 *Type/Acceptance Test (Four-Hour Test)*

The cable shall withstand, without breakdown, an ac voltage equal to 3 U_0 when applied to the sample between conductor and screen/armour (and between conductors in case of unscreened cables). The voltage shall be gradually increased to the specified value and maintained for a period of 4 h. If, while testing, interruption occurs during the 4 h period, the test shall be prolonged to the same extent. If interruption exceeds 30 min, the test shall be repeated.

23.7.2 *Routine Test*

The cable shall withstand, without breakdown, a power frequency ac voltage as specified below. The voltage shall be applied and increased gradually to the full value and maintained for 5 min.

Voltage Grade of Cable kV	*ac Test Voltage kV*	
	Between Conductor and Armour/Screen	Between Conductors[1]
1.9/3.3	10	10
3.8/6.6	12	20
6.35/11	17	
12.7/22	32	
19/33	48	-

[1] Not applicable for cables with screened cores.

23.7.3 For single core unscreened, unarmoured cables, the tests of **23.7.1** and **23.7.2** shall be carried out by immersing the core (with outer coverings removed) in water at room temperature for at least one hour (ends protruding) and then by applying the stipulated voltage between the conductor and water.

23.8 Flammability Test

Period of burning after removal of the flame shall not exceed 60 s and the unaffected (uncharred) portion from the lower edge of the top clamp shall be at least 50 mm.

SECTION 5 IDENTIFICATION, PACKING AND MARKING

24 IDENTIFICATION

24.1 Manufacturer's Identification

The manufacturer shall be identified throughout the length of the cable by means of tape bearing the manufacturer's name or trade-mark, or by manufacturer's name or trade-mark being printed, indented or embossed on the outer sheath. In case none of these methods are employed or if purchaser so desires, coloured identification threads in accordance with a scheme to be approved by the Bureau of Indian Standards shall be employed.

24.2 Voltage Identification

The voltage grade of the cable shall be identified throughout the length of the cable by means of a tape bearing the voltage grade of the cable [for example (6.35/11 kV) or (6 350/11 000 V) or by printing, embossing or indenting on the outer sheath].

NOTE — Single tape giving information required in 24.1 and 24.2 is also permissible.

24.3 Cable Code

The following codes shall be used for designating the cable:

Constituent	*Code Letter*
Aluminium conductor	A
Elastomer Insulation (Rubber)	R
Steel Round Wire Armour	W
Non-Magnetic Round Wire Armour	Wa
Steel Strip Armour	F
Non-Magnetic Strip Armour	Fa
Double Steel Strip Armour	FF
Double Steel Round Wire Armour	WW
Steel Braid	S
Non-Magnetic Metallic Braid	Sa
Elastomer Outer Sheath	R
PVC Outer Sheath	Y

NOTE — When conductor material is copper, no code letter is required for conductor.

25 PACKING AND MARKING

25.1 Packing

The cable shall be wound on a drum (*see* IS 10418) and packed. The ends of the cable shall be sealed by means of non-hygroscopic sealing material.

25.2 Marking

25.2.1 The drum shall carry the following information either stencilled on it or contained in a label attached to it:

- a) Reference to this standard, for example, Ref IS 9968 (Part 2);
- b) Manufacturer's name or trade-mark;
- c) Type of cable and voltage grade;
- d) Number of cores;
- e) Nominal cross-sectional area of conductor;
- f) Length of cable on the drum;
- g) Number of lengths on the drum (if more than one);
- h) Cable code;
- j) Direction of rotation of drum (by means of an arrow);
- k) Approximate gross mass; and
- m) Year of manufacture.

25.2.2 *BIS Certification Marking*

The cable (drum or label) may also be marked with the Standard Mark.

25.2.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

SECTION 6 TABLES

Table 1 Size of Earthing Conductor

(*Clause* 13.3)

Conductor	Sizes, mm²											
Power Conductor	16	25	35	50	70	95	120	150	185	240	300	400
Earthing Conductor	16	16	16	25	35	50	70	70	95	120	150	185

Table 2 Insulation Thickness

(*Clause* 15.2)

Conductor Size	Nominal Insulation Thickness (t)				
	1.9/3.3kV	3.8/6.6kV	6.35/11kV	12.7/22kV	19/33kV
(1)	(2)	(3)	(4)	(5)	(6)
mm²	mm	mm	mm	mm	mm
16	2.2	3.0	4.0	–	
25	2.2	3.0	4.0		
35	2.2	3.0	4.0	6.0	
50	2.2	3.0	4.0	6.0	8.8
70	2.2	3.0	4.0	6.0	8.8
95	2.4	3.0	4.0	6.0	8.8
120	2.4	3.0	4.0	6.0	8.8
150	2.4	3.0	4.0	6.0	8.8
185	2.4	3.0	4.0	6.0	8.8
240	2.4	3.0	4.0	6.0	8.8
300	2.4	3.0	4.0	6.0	8.8
400	2.6	3.0	4.0	6.0	8.8
500	2.8	3.2	4.0	6.0	8.8
630	2.8	3.2	4.0	6.0	8.8
800	2.8	3.2	4.0	6.0	8.8
1 000	3.0	3.2	4.0	6.0	8.8

Table 3 Thickness of Sheaths for Cables for Fixed Installations

(*Clauses* 19.2, 21.3.1 *and* 21.3.2)

Calculated Diameter of Laid up Cores for 3 Core Cables/of Core for Single Core Cables [As per IS 10462 (Part 1)]		Minimum Thickness of Inner Sheath	Thickness of Outer Sheath		
			Unarmoured Cables		Armoured Cables, Minimum
			Nominal	Minimum	
Above	Up to and Including				
(1)	(2)	(3)	(4)	(5)	(6)
		mm	mm	mm	mm
	10	0.8	1.2	0.76	0.76
10	15	1.0	1.5	1.0	1.0
15	20	1.0	1.7	1.16	1.16
20	25	1.2	1.9	1.32	1.32
25	30	1.2	2.1	1.48	1.48
30	40	1.4	2.4	1.72	1.72
40	50	1.6	2.7	1.96	1.96
50	60	1.8	3.1	2.28	2.28
60	70	2.0	3.5	2.6	2.6
70	80	2.2	3.8	2.84	2.84
80		2.4	4.0	3.0	3.0

Table 4 Thickness of Sheaths for Flexible Cables

(*Clauses* 19.2, 21.3.1 *and* 21.3.2)

Calculated Diameter of Laid-up Cores for 3-Core Cables/of Core for Single-Core Cables [As per IS 10462 (Part 1)]		**Minimum Thickness of Inner Sheath**	**Thickness of Outer Sheath**		
			Unarmoured Cables		Armoured Cables Minimum
Above	Up to and Including		Nominal	Minimum	
(1)	(2)	(3)	(4)	(5)	(6)
		mm	mm	mm	mm
—	10	1.0	1.6	1.08	1.08
10	15	1.2	2.0	1.4	1.4
15	20	1.4	2.2	1.56	1.56
20	25	1.6	2.5	1.8	1.8
25	30	1.8	3.0	2.2	2.2
30	40	2.0	3.5	2.6	2.6
40	50	2.4	4.0	3.0	3.0
50	60	2.8	4.5	3.4	3.4
60	70	3.2	5.0	3.8	3.8
70	80	3.6	5.5	4.2	4.2
80	—	4.0	6.0	4.6	4.6

Table 5 Dimensions of Armour Round Wires and Formed Wires

(*Clause* 20.2.1)

All dimensions in millimetres

Calculated Diameter Under Armour (Ref IS 10462 (Part 1)		***Nominal* Thickness of Steel Formed Wires**	***Nominal* Diameter of Steel Wire**
Above	Up to and Including		
(1)	(2)	(3)	(4)
—	13	—	1.40
13	25	0.8	1.60
25	40	0.8	2.00
40	55	0.8	2.50
55	70	0.8	3.15
70	—	0.8	4.00

Table 6 Dimension of Braiding Wire

(*Clause* 20.2.2)

All dimensions in millimetres

Calculated Diameter Under Braiding (Ref IS 10462 (Part 1)		**Nominal Diameter of Braiding Wire**
Above	Up to and Including	
(1)	(2)	(3)
—	25	0.30
25	—	0.35

NOTE — In case higher conductance is required, higher sizes may be used.

ANNEX A

(*Clause* 22.2.1)

SAMPLING OF CABLES

A-1 LOT

In any consignment the cables of the same size manufactured under essentially similar conditions of production shall be grouped together to constitute a lot.

A-2 SCALE OF SAMPLING

A-2.1 Samples shall be taken and tested from each lot for ascertaining the conformity of the lot to the requirements of the specification.

A-2.2 The number of samples to be selected shall be as given below:

No. of Drums in the Lot	*No. of Drums to be Taken as Sample*	*Permissible No. of Defectives*
(1)	(2)	(3)
up to 25	3	0
26 to 50	5	0
51 to 100	8	0
101 to 300	13	1
301 and above	20	1

A-2.2.1 These samples shall be taken at random. In order to ensure the randomness of selection procedure given in IS 4905 may be followed.

A-3 From each of the drums selected, suitable lengths of test samples shall be taken. These test samples shall be subjected to each of the acceptance tests (*see* **22.2**). A test sample is called defective if it fails in any one of the acceptance tests. If the number of defectives is less than or equal to the corresponding permissible number given in col 3 under **A-2.2** the lot shall be declared as conforming to the requirements of acceptance tests, otherwise not.

ANNEX B

(*Clauses* 16.4 *and* 22.2)

ELECTRICAL TEST ON SEMICONDUCTING NON-METALLIC SCREEN

B-1 A sample of cable shall be taken at least 300mm from the end of factory length and a test voltage of 70 V ac 40 Hz to 60 Hz, with a series resistance of 225 Ω connected to the test circuit shall be applied between a power conductor and the earth conductor.

B-2 A fault shall be created by means of 0.9 mm bare steel needle pushed through the outer sheath of the cable through the conducting elastomeric screen and into the power conductor. The leakage current shall be recorded and shall reach a value of not less than 125 mA within 10 ms from the instant the needle makes contact with the power conductor and shall not fall below 125 mA within 200 ms from that instant. Alternatively, the needle may be inserted before the test voltage is applied in which case the time interval and current flow are determined from the instant the voltage is switched on.

B-3 If the flow of current from any one core does not comply with the requirements specified under **B-2**. Two further tests on each of the three cores shall be carried out at approximately 150 mm and 300 mm respectively from the point of original measurement. If each of these additional tests produces a current flow that complies with the requirements of **B-2**, the cables shall be deemed to have satisfied the requirements.

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